

WHAT IS CLAIMED IS:

1 1. A reamer for enlarging a pre-existing hole in a workpiece by
2 rotational and axial cutting, the reamer comprising:

3 a longitudinal shank for supporting a body of the reamer for rotation
4 and for axial movement relative to the workpiece in a first hand rotational direction;
5 and

6 a longitudinal body extending axially from the shank, the body having
7 at least one first flute formed therein, providing at least one first flute cutting edge
8 in a distal end of the body for imparting a first cutting operation to the workpiece,
9 the body having at least one helical flute formed therein at an angle relative to an
10 axis of rotation that is greater than that of the at least one first flute, the at least one
11 helical flute being formed in a second hand rotational direction opposite to the first
12 hand rotational direction so that cutting debris is advanced ahead of the at least one
13 helical flute, the at least one helical flute providing at least one helical flute cutting
14 edge in the body distal end, radially spaced apart from the at least one first flute
15 cutting edge, for imparting a helical cutting operation to the workpiece so that at
16 least a leading portion of the at least one first flute and the at least one helical flute
17 cutting edges generally lie in a common radial plane;

18 wherein the at least one first flute cutting edge and the at least one
19 helical flute cutting edge concurrently and collectively perform the first and helical
20 cutting operations to a sculpture surface of the workpiece, thereby improving
21 tolerances of the cutting operations, varying the loads imparted to the workpiece and
22 the reamer, and reducing heat generated between the workpiece and the reamer.

1 2. The reamer of claim 1 wherein the at least one first flute is
2 further defined as at least one straight flute.

1 3. The reamer of claim 1 wherein the at least one first flute
2 cutting edge is further defined as at least one straight flute cutting edge.

1 4. The reamer of claim 1 wherein a longitudinal dimension
2 between the at least one first flute cutting edge and the at least one helical flute

3 cutting edge is less than ten percent of an overall transverse dimension of the reamer
4 body.

1 5. The reamer of claim 1 wherein the body is generally
2 cylindrical.

1 6. The reamer of claim 1 wherein the body includes at least one
2 cylindrical margin formed thereabout for providing bearing support to the reamer
3 within the hole being formed.

1 7. The reamer of claim 1 wherein the longitudinal body has an
2 imaginary plane extending axially through the axis of rotation, and the at least one
3 first flute is formed ahead of the imaginary plane in the first hand rotational
4 direction thereby providing a negative rake angle to the at least one first flute cutting
5 edge.

1 8. The reamer of claim 1 wherein the longitudinal body has an
2 imaginary plane extending axially through the axis of rotation, and the at least one
3 helical flute is formed ahead of the imaginary plane in the first hand rotational
4 direction thereby providing a negative rake angle to the at least one helical flute
5 cutting edge.

1 9. The reamer of claim 1 wherein the body includes at least one
2 longitudinal margin generally aligned with the at least one first flute for providing
3 bearing support to the reamer within the hole being formed.

1 10. The reamer of claim 1 wherein the body includes at least one
2 helical margin generally aligned with the at least one helical flute for providing
3 bearing support to the reamer within the hole being formed.

1 11. The reamer of claim 1 wherein the body further includes at
2 least one gash formed in the body distal end extending outwardly in relation to an
3 axis of rotation and intersecting the at least one first flute and the at least one helical

4 flute for assisting removal of debris from the at least one helical flute cutting edge.

1 12. The reamer of claim 1 wherein the shank includes an ingress
2 port for receiving a cutting fluid and for transmitting the cutting fluid through a fluid
3 passage, and the body includes at least one egress port connected to the fluid passage
4 and formed within either of the at least one first flute and the at least one helical
5 flute for conveying the cutting fluid to the associated cutting edge and the sculpture
6 surface defined within the workpiece.

1 13. The reamer of claim 1 wherein the body further includes at
2 least one relief surface formed at least partially along the at least one helical flute
3 cutting edge, the at least one relief surface having a first relief angle which is
4 inclined in relation to a radial plane and a direction of cutting edge travel, the body
5 including at least one other relief surface formed at least partially along the at least
6 one first flute cutting edge, the at least one other relief surface having a second relief
7 angle that is less than the first relief angle.

1 14. The reamer of claim 1 wherein the at least one first flute
2 cutting edge comprises a leading edge inclined in relation to a radial plane.

1 15. The reamer of claim 1 further comprising a pilot extending
2 axially forward from the body distal end, the pilot being sized to be received within
3 the pre-existing hole to provide bearing support to reamer within the hole being
4 formed.

1 16. The reamer of claim 1 wherein the at least one first flute
2 cutting edge comprises an end cutting edge formed at an intersection of the at least
3 one first flute and the distal end of the body, and a leading edge inclined in relation
4 to a radial plane.

1 17. The reamer of claim 1 wherein the body further includes at
2 least one primary relief surface formed along the at least one primary flute cutting
3 edge having a primary relief angle.

1 18. The reamer of claim 17 wherein the body further includes at
2 least one secondary relief surface formed along the at least one primary relief
3 surface spaced apart from the at least one primary flute cutting edge having a
4 secondary relief angle that is greater than the primary relief angle.

1 19. The reamer of claim 1 wherein the at least one first flute
2 further comprises an array of first flutes.

1 20. The reamer of claim 19 wherein the array of first flutes has
2 an angular spacing tolerance between sequential first flutes that is equal to or less
3 than four radial quadrants divided by twice the number of first flutes in the array in
4 order to vary the loads imparted to the workpiece and the reamer.

1 21. The reamer of claim 1 wherein the at least one helical flute
2 further comprises an array of helical flutes.

1 22. The reamer of claim 21 wherein the array of helical flutes has
2 an angular spacing tolerance between sequential helical flutes that is equal to or less
3 than four radial quadrants divided by twice the number of helical flutes in the array
4 in order to vary the loads imparted to the workpiece and the reamer.

1 23. The reamer of claim 1 wherein the at least one first flute
2 further comprises an array of first flutes and the at least one helical flute further
3 comprises an array of helical flutes.

1 24. The reamer of claim 23 wherein the number of first flutes in
2 the first flute array is equal to the number of helical flutes in the helical flute array.

1 25. The reamer of claim 23 wherein the number of first flutes is
2 equal to three.

1 28. A reamer for enlarging a pre-existing hole in a workpiece by
2 rotational and axial cutting, the reamer comprising:

3 a longitudinal shank for supporting a body of the reamer for rotation
4 and for axial movement relative to the workpiece in a first hand rotational direction;
5 and

6 a longitudinal body extending axially from the shank, the body having
7 at least one first flute formed therein, providing at least one first flute cutting edge
8 in a distal end of the body for imparting a first cutting operation to the workpiece,
9 the body having at least one helical flute formed therein in a second hand rotational
10 direction opposite to the first hand rotational direction so that cutting debris is
11 advanced ahead of the at least one helical flute, the at least one helical flute being
12 non-intersecting with the at least one first flute at the body distal end, the at least
13 one helical flute providing at least one helical flute cutting edge in the body distal
14 end, radially spaced apart from the at least one first flute, for imparting a helical
15 cutting operation to the workpiece;

16 wherein the at least one first flute cutting edge and the at least one
17 helical flute cutting edge concurrently and collectively perform the first and helical
18 cutting operations to a sculpture surface of the workpiece, thereby improving
19 tolerances of the cutting operations, varying the loads imparted to the workpiece and
20 the reamer and reducing heat generated between the workpiece and the reamer.

3 providing a reamer having at least one first flute with at least one first
4 flute cutting edge in a distal end of the reamer, the reamer having at least one helical

5 flute formed therein canted relative to the at least one first flute, with at least one
6 helical flute cutting edge in the distal end of the reamer;
7 rotating one of the reamer or a workpiece; and
8 translating one of the reamer or the workpiece towards another so that
9 the reamer is fed into the pre-existing hole, and the at least one first flute cutting
10 edge and the at least one helical flute cutting edge concurrently and collectively
11 provide cutting operations to a sculpture surface formed within the pre-existing hole.